

Learning Bentley STAAD.Pro V8i

for Structural Analysis

CADCIM Technologies

*525 St. Andrews Drive
Schererville, IN 46375, USA
(www.cadcim.com)*

Contributing Author

Sham Tickoo

*Professor
Purdue University Calumet
Hammond, Indiana, USA*

DEDICATION

*To teachers, who make it possible to disseminate knowledge
to enlighten the young and curious minds
of our future generations*

*To students, who are dedicated to learning new technologies
and making the world a better place to live in*

THANKS

To employees of CADCIM Technologies for their valuable help

Online Training Program Offered by CADCIM Technologies

CADCIM Technologies provides effective and affordable virtual online training on various software packages including Computer Aided Design and Manufacturing (CAD/CAM), computer programming languages, animation, architecture, and GIS. The training is delivered 'live' via Internet at any time, any place, and at any pace to individuals as well as the students of colleges, universities, and CAD/CAM training centers. The main features of this program are:

Training for Students and Companies in a Classroom Setting

Highly experienced instructors and qualified engineers at CADCIM Technologies conduct the classes under the guidance of Prof. Sham Tickoo of Purdue University Calumet, USA. This team has authored several textbooks that are rated "one of the best" in their categories and are used in various colleges, universities, and training centers in North America, Europe, and in other parts of the world.

Training for Individuals

CADCIM Technologies with its cost effective and time saving initiative strives to deliver the training in the comfort of your home or work place, thereby relieving you from the hassles of traveling to training centers.

Training Offered on Software Packages

CADCIM provides basic and advanced training on the following software packages:

***CAD/CAM/CAE:** CATIA, Pro/ENGINEER Wildfire, Creo Parametric, Creo Direct, SolidWorks, Autodesk Inventor, Solid Edge, NX, AutoCAD, AutoCAD LT, AutoCAD Plant 3D, Customizing AutoCAD, EdgeCAM, and ANSYS*

***Architecture and GIS:** Autodesk Revit Architecture, AutoCAD Civil 3D, Autodesk Revit Structure, AutoCAD Map 3D, Revit MEP, Navisworks, Primavera, and Bentley STAAD Pro*

***Animation and Styling:** Autodesk 3ds Max, Autodesk 3ds Max Design, Autodesk Maya, Autodesk Alias, The Foundry NukeX, and MAXON CINEMA 4D*

***Computer Programming:** C++, VB.NET, Oracle, AJAX, and Java*

For more information, please visit the following link: <http://www.cadcim.com>

Note

*If you are a faculty member, you can register by clicking on the following link to access the teaching resources: <http://www.cadcim.com/Registration.aspx>. The student resources are available at <http://www.cadcim.com>. We also provide **Live Virtual Online Training** on various software packages. For more information, write us at sales@cadcim.com.*

Table of Contents

Dedication	iii
Preface	xi

Chapter 1: Introduction to STAAD.Pro V8i

Introduction to STAAD.Pro V8i	1-2
Basic Features of STAAD.Pro V8i	1-2
Starting Bentley STAAD.Pro V8i	1-2
User Interface	1-3
Project Tasks	1-3
Recent Files	1-4
Help Topics	1-4
License Configuration	1-4
Starting a New Project	1-4
Working in User Interface	1-7
Menu Bar	1-7
Toolbars	1-14
Side Toolbar	1-14
Tabs	1-14
Snap Node/Beam Window	1-17
Data Area	1-17
Main Window	1-17
Opening an Existing Project	1-19
Saving a Project	1-19
Configuring Units	1-19
Keyboard Shortcuts	1-21
Importing A model in staad.pro	1-21

Chapter 2: Structural Modeling in STAAD.Pro

Introduction	2-2
Structural Modeling Using STAAD Editor	2-2
Creating Nodes	2-3
Creating Members	2-7
Creating Plate Elements	2-12
Creating Solid and Surface Elements	2-15
Structural Modeling Using STAAD GUI	2-17
Creating Nodes and Members Using Snap Node/Beam Method	2-17
Creating Plate Elements Using the Snap Node/Plate Method	2-23
Creating Solid Elements Using the Snap Node/Solid Method	2-24
Structural Modeling using the Structure Wizard	2-27
Truss Models	2-28
Frame Models	2-30
Surface/Plate Models	2-31

Solid Models	2-32
Composite Models	2-33
Import CAD Models	2-34
VBA Macro Models	2-34
Self-Evaluation Test	2-37
Review Questions	2-38

Chapter 3: Structural Modeling Using Tools

Introduction	3-2
Essential tools for Structural Modeling	3-2
Adding Beams Using Tools	3-2
Creating Colinear Beams	3-7
Creating Beams Along Axes	3-7
Creating Plates Using Tools	3-8
Creating Plates Using Meshing	3-8
Creating Infill Plates	3-11
Creating a Surface Using the Add Surface Tool	3-12
Creating Solid Elements Using the Add Solid Tool	3-15
Creating a Structure Using the Translational Repeat Tool	3-15
Creating a Structure Using the Circular Repeat Tool	3-16
Shifting Structure Using Move Tool	3-19
Rotating Structure Using the Rotate Tool	3-20
Mirroring a Structure	3-22
Other Miscellaneous Tools	3-24
Stretching Members Using Stretch Tool	3-24
Intersecting Members Using the Intersect Tool	3-25
Merging Members and Nodes	3-25
Renumbering Nodes, Members, and Elements	3-26
Splitting and Breaking Beams at Selected Nodes	3-27
Cutting Sections	3-28
Self-Evaluation Test	3-31
Review Questions	3-32

Chapter 4: Defining Material Constants and Section Properties

Introduction	4-2
Material Constants	4-2
Creating New Materials	4-3
Editing Material Properties	4-4
Assigning Materials to the Structure	4-4
Defining Orthotropic Material	4-5
Section Properties	4-7
Prismatic Section	4-7
Tapered Sections	4-10
Steel Sections	4-12
Steel Joist and Joist Girders	4-14
Plate/Surface Thickness	4-14
Self-Evaluation Test	4-17
Review Questions	4-18

Chapter 5: Specifications and Supports

Introduction	5-2
Node Specification	5-2
Member Specifications	5-5
Release	5-6
Offset	5-7
Property Reduction Factors	5-9
Cable	5-9
Truss	5-10
Compression	5-10
Tension	5-10
Inactive	5-10
Fire Proofing	5-11
Imperfection	5-11
Plate Specifications	5-11
Release	5-12
Ignore Inplane Rotation	5-12
Plane Stress	5-12
Ignore Stiffness	5-12
Supports	5-13
Fixed	5-14
Pinned	5-14
Fixed But	5-14
Enforced	5-15
Enforced But	5-15
Multilinear Spring	5-15
Foundation	5-15
Inclined	5-16
Tension/Compression Only Springs	5-17
Self-Evaluation Test	5-19
Review Questions	5-19

Chapter 6: Loads

Introduction	6-2
Primary Loads	6-2
Selfweight	6-3
Nodal Loads	6-4
Member Loads	6-5
Area Load	6-10
Floor Load	6-10
Plate Loads	6-13
Surface Loads	6-18
Solid Load	6-20
Temperature Load	6-21
Seismic Load	6-21
Time History Load	6-29

Wind Load	6-34
Snow Load	6-41
Response Spectra	6-43
Repeat Load	6-49
Frequency	6-51
Load generation	6-51
Defining Vehicle Loading	6-51
Defining Load Combinations	6-58
Defining Load Combinations Automatically	6-59
Self-Evaluation Test	6-61
Review Questions	6-61

Chapter 7: Performing Analysis, Viewing Results, and Preparing Report

Introduction	7-2
Pre Analysis Print	7-2
Problem Statistics	7-3
Joint Coordinates	7-3
Member Information	7-3
Material Properties	7-3
Support Information	7-3
Member Properties	7-3
Element Information	7-3
Solid Information	7-4
All	7-4
Entire Table	7-4
Performing Analysis	7-4
Perform Analysis	7-4
PDelta Analysis	7-5
Perform Cable Analysis	7-5
Perform Direct Analysis	7-7
Perform Imperfection Analysis	7-7
Perform Buckling Analysis	7-8
Perform Pushover Analysis	7-8
Post Analysis Print	7-8
Load List	7-8
Joint Displacement	7-8
Member Forces	7-9
Support Reactions	7-9
Story Drift	7-9
Cg	7-9
Mode Shapes	7-10
Section Displacement	7-10
Force	7-10
Analysis Results	7-10
Member Stresses	7-10
Element Forces/Stresses	7-10

Viewing Results	7-11
View Output File	7-11
Go to Post Processing Mode	7-13
Self-Evaluation Test	7-29
Review Questions	7-30
Index	I-1

Conversion Table

Conversion Table-Metric/Imperial			
	Unit	Multiply By (Factor)	To Obtain
Length	Inch	2.54	Centimeter
	Centimeter	0.393	Inch
	Feet	0.301	Meter
	Meter	3.281	Feet
	Kilometer	0.54	Nautical Mile
	Nautical Mile	1.852	Kilometer
	Feet	0.000304	Kilometer
Weight and Mass	Ounce	28.35	Gram
	Gram	0.0353	Ounce
	Pound	0.453	Kilogram
	Kilogram	2.205	Pounds
	Metric Ton	1.102	Ton
Liquid Measures	Fluid Ounce	0.0296	Liter
	Gallon	3.785	Liter
	Liter	0.264	Gallon
Thrust / Pressure	Pounds Force	4.448	Newton
	Newton	0.225	Pound
	Pound per square inch (psi)	6.895	KiloPascal
Temperature	Kelvin	1	Degree Celsius-273.15
	Degree Celsius	1.8	Degree Fahrenheit +32

Preface

STAAD.Pro V8i

STAAD.Pro V8i, developed by Bentley Systems, is a powerful software used for structural analysis and design. It has various tools that help in modeling 2D and 3D models. These tools analyze and virtually design any type of structure. This enables the users to automate their tasks, and remove the tedious long procedures involved in the manual methods. STAAD.Pro is an effective tool for structural engineers and construction professionals.

STAAD.Pro has an extremely flexible modeling environment that helps in creating accurate models quickly and accurately. It supports broad ranges of Steel, Concrete, Aluminium, and Timber design codes. It is capable of analyzing any structure for static loads, dynamic response, soil-structure interaction, wind, earthquake, and moving loads. STAAD.Pro supports Bentley Rebar, AutoPipe, RAM Connection, STAAD.Foundation, and other software.

Learning Bentley STAAD.Pro V8i is a comprehensive textbook that has been written to cater to the needs of the students and professionals. The chapters in this textbook are structured in a pedagogical sequence, which makes the learning process very simple and effective for both the novice as well as the advanced users of STAAD.Pro. In this textbook, the author explains in detail the procedure of creating 2D and 3D models, assigning material constants, assigning cross-section properties, assigning supports, defining different loads, performing analysis, viewing results, and preparing report. The chapters in the book are punctuated with tips and notes, wherever necessary, to make the concepts clear, thereby enabling the user to create his own innovative projects.

The highlight of this textbook is that each concept introduced in it is explained with the help of suitable examples to facilitate better understanding. The simple and lucid language used in this textbook makes it a ready reference for both the beginners and the intermediate users.

- **Concepts explained with Examples**
The author has explained the concepts in detail with examples for better comprehension of the processes involved.
- **Tips and Notes**
The additional information related to topics is provided to the users in the form of tips and notes.
- **Learning Objectives**
The first page of every chapter summarizes the topics that are covered in that chapter.
- **Self-Evaluation Test and Review Questions**
Every chapter ends with Self-Evaluation Test so that the users can assess their knowledge of the chapter. The answers to Self-Evaluation Test are given at the end of the chapter. Also, the Review Questions are given at the end of chapters and they can be used by Instructors as test questions.

- **Heavily Illustrated Text**
The text in this book is heavily illustrated with screen capture images.

Symbols Used in the Textbook



Note

The author has provided additional information related to various topics in the form of notes.



Tip

The author has provided a lot of information to the users about the topic being discussed in the form of tips.

Unit System Followed in the Textbook

In this book, the Metric system has been used as the default unit system.

Formatting Conventions Used in the Textbook

Please refer to the following list for the formatting conventions used in this textbook.

- Names of tools, buttons, options, menu, command, pages, and tabs are written in boldface. Example: The **Add Beams** tool, the **OK** button, the **File** menu, the **Modeling** tab, the **General** page, and so on.
- Names of dialog boxes, menus, windows, edit boxes, check boxes, and radio buttons are written in boldface. Example: The **Property** dialog box, the **Density** edit box of the **Property** dialog box, and so on.
- Values entered in edit boxes are written in boldface. Example: Enter **Buildings** in the **Name** edit box.
- Names of the files are italicized. Example: *c03_staad_v8i_ex1*

Naming Conventions Used in the Textbook

Tool

If you click on an item in a toolbar and a command is invoked to create/edit an object or perform some action, then that item is termed as tool. For example: **Insert Node** tool and **Translational Repeat** tool, refer to Figure 1.



Figure 1 The tools available in a toolbar

Button

The item in a dialog box that has a 3d shape is termed as Button. For example, **OK** button, **Cancel** button, **Apply** button, and so on.

Dialog Box

In this textbook, different terms are used to indicate various components of a dialog box, refer to Figure 2.

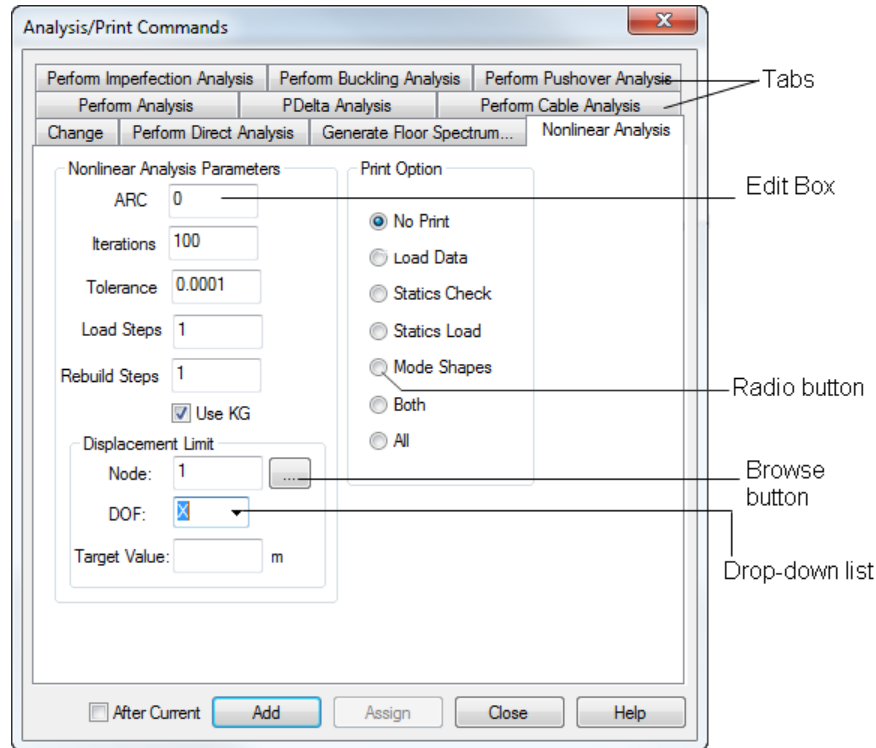


Figure 2 Different components of a dialog box

Menu

A menu is the one in which a set of common tools and options are grouped together. These menus are given a name based on the tools grouped in them. For example, **Mode** menu, **Geometry** menu, and so on, refer to Figure 3.

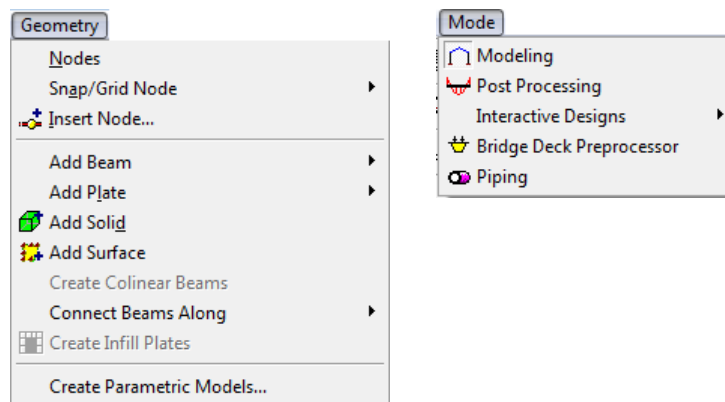


Figure 3 The partial view of **Geometry** and **Mode** menus

Options

Options are the items that are available in shortcut menus, dialog boxes, drop-down lists, and so on. For example, choose the **Orientation** option from the shortcut menu displayed on right-clicking in the Main Window, refer to Figure 4.

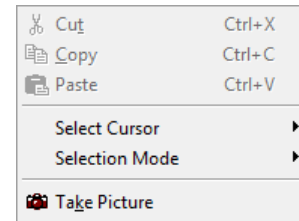


Figure 4 The shortcut menu displayed in the main window

Free Companion Website

It has been our constant endeavor to provide you the best textbooks and services at affordable price. In this endeavor, we have come out with a Free Companion website that will facilitate the process of teaching and learning of STAAD.Pro V8i. If you purchase this textbook, you will get access to the files on the Companion website.

The resources available for the faculty and students in this website are as follows:

Faculty Resources

- **Technical Support**

You can get online technical support by contacting techsupport@cadcim.com.

- **Instructor Guide**

Solutions to all review questions and exercises in the textbook are provided in the instructor guide to help the faculty members test the skills of the students.

- **PowerPoint Presentations**

The contents of the book are arranged in PowerPoint slides that can be used by the faculty for their lectures.

- **Example Files**

The example files used are available for free download.

Student Resources

- **Technical Support**

You can get online technical support by contacting techsupport@cadcim.com.

- **Example Files**

The example files used are available for free download.

If you face any problem in accessing these files, please contact the publisher at sales@cadcim.com or the author at stickoo@purduecal.edu or tickoo525@gmail.com.

Stay Connected

You can now stay connected with us through Facebook and Twitter to get the latest information about our textbooks, videos, and teaching/learning resources. To stay informed of such updates, follow us on Facebook (www.facebook.com/cadcim) and Twitter (@cadcimtech). You can also subscribe to our YouTube channel (www.youtube.com/cadcimtech) to get the information about our latest video tutorials.